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1) South African Patent Application No. **99/0969** accompanied by a Provisional Specification was filed at the South African Patent Office on the **8 February 1999**, in the name of **SAPPI LIMITED** in respect of an invention entitled: **"TIMBER PROCESS AND PRODUCT"**.

2) The photocopy attached hereto is a true copy of the provisional specification and drawings filed with South African Patent Application No. **99/0969**.

[redacted]TORIA in die Republiek van Suid-Afrika, hierdie 14th dag van March 2000
in the Republic of South Africa, this day of

Registrateur van Patente
Registrar of Patents

D.M. KISCH INC. , J hann sburg

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REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30 (1) - Regulation 22)
The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

PATENT APPLICATION NO.			AGENT'S REFERENCE
21	01	990969	P/99/77423

FULL NAME(S) OF APPLICANT(S)

71 SAPPI LIMITED
a South African Company

ADDRESS(ES) OF APPLICANT(S)

48 Ameshoff Street
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Johannesburg, Gauteng Province
South Africa

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TITLE OF INVENTION

54 TIMBER PROCESS AND PRODUCT

THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2.
The earliest priority claimed is

THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO.	21	01	
THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND BASED ON APPLICATION NO.	21	01	

THIS APPLICATION IS ACCOMPANIED BY :

X	1	A single copy of a provisional ~~xxxxxxxxxxxxxxxxxxxxxxxxx~~ specification of 9 pages.
	2	Drawings of sheets.
	3	Publication particulars and abstract (Form P.8. in duplicate).
	4	A copy of Figure of the drawings for the abstract.
	5	An assignment of invention.
	6	Certified priority document(s) (State number).
	7	Translation of priority document(s).
	8	An assignment of priority rights.
	9	A copy of Form P.2 and specification of S.A. Patent Application No. 21 01
	10	A declaration and power of attorney on Form P.3.
	11	Request for ante-dating on Form P.4.
	12	Request for classification on Form P.9.
	13	

DATED THIS 8 th **DAY OF** February **19** 99

Patent Attorney for the Applicant(s)

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REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978.

PROVISIONAL SPECIFICATION

(Section 30 (1) - Regulation 27)

PATENT APPLICATION NO.	LODGING DATE.	AGENT'S REFERENCE
21 01 990969	22 08-02-1999	P/99/77423

FULL NAME(S) OF APPLICANT(S)

71 SAPPI LIMITED

FULL NAME(S) OF INVENTOR(S)

72 SYDNEY MABOKA

TITLE OF INVENTION

54 TIMBER PROCESS AND PRODUCT

TITLE OF INVENTION: TIMBER PROCESS AND PRODUCT

INTRODUCTION:

This invention relates to a timber process and product. More particularly this invention relates to a timber process for manufacturing so-called particle board or chipboard, and to a timber product in the form of such particle board or chipboard when manufactured by or from the aforementioned process.

BACKGROUND TO THE INVENTION:

It is known in the manufacture of particle board or chipboard (hereinafter referred to as "chipboard") that a urea-formaldehyde resin is used as a binder or adhesive to bond the particles or chips of wood.

Typically such binders contain approximately 55% to 60% formaldehyde (in moles) but because of r cent awar ness of the h alth problems

associated with th use of formaldehyde, the amount of formald hyde in such resins is generally being reduced. Hence the amount of formaldehyde in the aforementioned r sins has been reduc d to approximately 50% or less (in moles).

The aforementioned resins need to be cured, and the curing process is accelerated by heating in a press under pressure i.e. heat is applied by hot metal platens on both sides of a so-called mat of glued chips. Chipboard pressing takes place either in a batch-type (using daylight presses) or in a continuous process i.e. using continuous (for example roller) presses.

It is also known in the chipboard industry that methyl di-isocyanate (hereinafter referred to as "MDI") may be added to the aforementioned resin to hasten the curing process i.e. to effectively increase the speed of the curing process or reduce the curing time. However, because of the high cost of MDI and the amount required to effectively hasten the curing process, the use of MDI is not cost-effective on an industrial scale.

OBJECTS OF THE INVENTION:

It is accordingly a general object of the present invention to provide an improved binding mixture for chipboard manufacture.

It is also an object of the present inventi n to provide an improved curing mixture, and hence a process in which such improved curing mixture is used, which is both cost-effective and which increases the efficiency and rate of curing of the binding mixture and hence leads to an increase in productivity or production flowing from the aforementioned.

It is a further object of the invention that the aforementioned binding mixture and process will lead to an increase in productivity or production flowing from shorter curing periods resulting from the aforementioned binding mixture.

SUMMARY OF THE INVENTION:

According to one aspect of the present invention, there is provided a binding mixture for use in manufacturing chipboard, the mixture including an effective amount of MDI and a catalyst selected from one or more of the following:

(a) an amine or amine compound including aliphatic and aromatic tertiary amines; and/or

(b) an organometallic catalyst including tin-based compounds and alkali metal salts.

T th MDI may b added an effective amount f toluene di-isocyanat ("TDI") and one or more release agents.

The aforementioned mixture may of course include a suitable amount of urea-formaldehyde which may or may not have suitable quantities of polyol(s) added thereto. The amount of formaldehyde in the aforementioned urea-formaldehyde resin may preferably be approximately 50% (in moles).

By using a catalyst as aforesaid, the effective amount of MDI required is reduced relative to the amounts known in the prior art to be sufficient to hasten the curing process of the mixture.

Suitable amines or amine compounds may include the following:

2-dimethyl ethanolamine (hereinafter referred to as "DMAE");
di-amino bicyclo-octane (hereinafter referred to as "DABCO"); and
N,N-dimethyl cyclohexylamine (hereinafter referred to as "DMCHA");

Suitable organometallic tin-based compounds may include the following: Stannous octoate, dibutyl tin dilaurate, dibutyl tin mercaptide, dibutyl tin thiocarboxylate, and dioctyl tin thiocarboxylate.

Suitable alkali metal salts may include:

Salts of carbonic acid and salts of acetic acid.

Other suitable organometallic compounds may include:

Calcium carbonate, and ferric acetylacetonate.

One supplier of the above catalysts (as mixtures or single compounds) is Air Products, South Africa and the catalysts may be identified inter alia by the following trade marks, respectively:

DMAE, Dabco R8020, Dabco DC-1, DABCO DC 2, DABCO K-15, Dabco TMR 2, DMCHA (Polycat 8), Thorcat 401.

When used with one or more of the above catalysts, the amount of MDI required to effect a suitable hastening of the curing process may preferably be in the range 0.1% to 1.4% on bone dry wood (hereinafter referred to as "BDW").

According to another aspect of the present invention, there is provided an additive for a binding mixture for use in manufacturing chipboard, the additive including an effective amount of MBI and a catalyst, as indicat d above, and as therwise describ d herein.

According to a further aspect of the present invention, there is provided a process for manufacturing chipboard, the process including th step of adding t or using in a binding mixture consisting f urea-formaldehyde, an effective amount of MDI and a catalyst, as indicated above, or as otherwise herein described, or an additive as herein described.

DETAILED DESCRIPTION OF THE INVENTION:

The invention will now be described in greater detail by way of non-limiting example(s), with reference to the following:

1. LABORATORY TESTS:

Laboratory tests were carried out by personnel of the applicant's wholly owned subsidiary namely Sappi Timber Industries (Proprietary) Limited on wood particles and chips as used for manufacturing chipboard in the factories of the aforementioned company.

Using the aforementioned raw materials, binder mixtures of urea-formaldehyde as typically used in the aforementioned company's production facilities were applied to the aforementioned particle chips, and compared with urea-formaldehyde mixtures including MDI, and further compared with mixtures of ur a-f rmaldehyde with MDI

and various catalysts as set out above.

The resulting mixtures of particles/chips and binder mixtures were pressed in a laboratory scale press to simulate plant production conditions, and curing times were measured. In the binding mixtures that did not include a catalyst, longer curing times were observed. The curing times for mixtures where typically 0.1% to 1.4% MDI and one or more of the abovementioned catalysts were added (on BDW), were the shortest.

Hardness, breakage and other relevant tests were applied to the cured samples to ensure that the correct level of curing and resulting strength had been achieved.

The results of the above tests indicated that in all cases the binding mixtures with MDI and one or more catalysts resulted in a shorter curing period with the same or an increased binding strength.

Improvements of up to approximately 34% were obtained in terms of increased curing speed.

It was also found that the use of amines as catalysts alone resulted in the least costly and hence most cost-effective process.

2. **PRODUCTION-LINE TESTS:**

The aforementioned tests were repeated by way of reasonable technical trials on two different production lines namely one using a single daylight press and the other using a continuous press.

The abovementioned production-line tests confirmed the aforementioned laboratory results, with improvements in or increased curing times of up to approximately 14 to 18%, and in some instances even greater improvements were obtained. The applicant believes that it may be possible to achieve greater improvements than the aforementioned.

It will therefore be seen from the aforementioned that a considerable improvement in productivity may be possible by using the aforementioned invention. Such improvement also appears to be cost-effective relative to increased productivity and production on an industrial scale.

Although certain embodiments only of the have been described herein, it will be apparent to any person skilled in the art that other variations and/or modifications of the invention are possible. Such variations and/or modifications are therefore to be considered as falling within the spirit and scope of the invention as herein described.

Dated this 8 day of February 1999

Attorney/Agent for the Applicant

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TIMBER PROCESS AND PRODUCT

INTRODUCTION

This invention relates to a timber process and product. More particularly this invention relates to a process for manufacturing so-called particle board or chipboard, and to a timber product in the form of such particle board or chipboard when manufactured by or from the aforementioned process.

BACKGROUND TO THE INVENTION

It is known in the manufacture of particle board or chipboard (hereinafter referred to as "chipboard") that a urea-formaldehyde resin (hereinafter referred to as "UF") is used as a binder or adhesive to bond the particles or chips of wood.

Typically such binders contain approximately 55% to 60% formaldehyde (in moles) but because of recent awareness of the health problems associated with the use of formaldehyde, the amount of formaldehyde in such resins is generally being reduced. Hence the amount of formaldehyde in the aforementioned resins has been reduced to approximately 50% or less (in moles).

The aforementioned resins need to be cured, and the curing process is accelerated by heating in a press under pressure i.e. heat is applied by hot metal platens on both sides of a so-called mat of glued chips. Such chipboard pressing takes place either in a batch-type (using daylight presses) or in a continuous process i.e. using continuous (for example roller) presses.

It is also known in the chipboard industry that methyl di-isocyanate (hereinafter referred to as "MDI") may be added to the aforementioned type of resin to hasten the curing process i.e. to effectively increase the speed of the curing process and hence to reduce the curing time. However, because of the high cost of MDI and the amount required to effectively hasten the curing process, the use of MDI is not cost-effective on an industrial scale.

OBJECTS OF THE INVENTION

It is accordingly a general object of the present invention to provide an improved binding mixture for chipboard manufacture.

It is also an object of the present invention to provide an improved process in which such improved mixtur is used, which is both cost-effective and which increases the efficiency and rate of curing of the binding mixture.

It is a further object of the invention that the aforementioned binding mixture and process will lead to an increase in productivity or production flowing from shorter curing periods resulting from use of the aforementioned binding mixture.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, there is provided a binding mixture for use in manufacturing chipboard, the mixture including an effective amount of MDI and one or more polyurethane catalyst(s) being selected from the following:

(a) one or more amine compound(s) including aliphatic and aromatic tertiary amine derivatives of phenols, esters, ethers, alkenes and/or alcohols; or

(b) one or more organometallic compound(s) of tin, bismuth, zinc, iron and/or alkali metal salt(s); or

(c) suitable mixtures of (a) and (b) above.

The MDI may or may not be water-emulsifiable, and the or each polyurethane catalyst(s) may or may not be (a) delayed-action catalyst(s).

To the mixture may be added an effective amount of toluene di-isocyanate ("TDI") and/or one or more internal wetting and release agents.

The aforementioned mixture(s) may of course include a suitable amount of urea-formaldehyde resin which may or may not have suitable quantities of polyol(s) added thereto.

The amount of formaldehyde in the aforementioned urea-formaldehyde resin may preferably be approximately 50% (in moles) i.e. may be less than, equal to, or more than 50% (in moles).

By using a catalyst as aforesaid, the effective amount of MDI required is reduced relative to the amounts known in the prior art to be sufficient to hasten the curing process of the mixture.

Suitable amines or amine compounds may be selected from the following:

2-dimethylethanolamine (hereinafter referred to as "DMEA");

di-aminebicyclo-octane (hereinafter referred to as "DABCO"); and

N,N-dimethyl cyclohexylamine (hereinafter referred to as "DMCHA").

Suitable organometallic tin-based compounds may be selected from the following:

stannous octoate, dibutyl tin dilaurate, dibutyl tin mercaptide, dibutyl tin thiocarboxylate, and dioctyl tin thiocarboxylate.

Other suitable organometallic compounds may include ferric acetylacetonate.

Suitable alkali metal salts may be selected from the following:

calcium carbonate, salts of carbonic acid, and salts of acetic acid.

One supplier of the above catalysts (as mixtures or single compounds) is Air Products, South Africa, and the catalysts may be identified inter alia by the following trade marks/brands and/or acronyms, respectively:

CHEMICAL BRAND NAME	ACTIVE INGREDIENT(S)
DMEA	2-Dimethyl ethanolamine
DABCO	Di-amino bicyclo-octane
POLYCAT 8 (DMCIIA)	N,N-dimethyl cyclohexylamine
DABCO R-8020	Triethylenediamine and Dimethylethanolamine
DABCO DC-1	Tin and amine complexes
DABCO DC-2	Tin and amine complexes
DABCO K-15	Potassium octate and diethylene glycol
DABCO TMR 2	Quaternary ammonium salt in ethylene glycol
THORCAT 401	Di-N-butyltindilaurate

When used with one or more of the above catalysts, the amount of MDI required to effect a suitable hastening of the curing process may preferably be in the range of about 0.1% to 1.9% on bone dry wood (hereinafter referred to as "BDW").

According to another aspect of the present invention, there is provided an additive for a binding mixture for use in manufacturing chipboard, the additive including an effective amount of MDI and a catalyst, each as indicated above, and as otherwise described herein.

According to a further aspect of the present invention, there is provided a process for manufacturing chipboard, the process including the steps of

adding to or using in a binding mixture consisting of ur a-formaldehyde resin, an effective amount of MDI and a catalyst, each catalyst being as indicated above, or as otherwise herein described, or an additive, respectively, as herein described, and suitably mixing the binding mixture with wood particles and/or chips.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described in greater detail by way of non-limiting example(s), with reference to the following:

1. LABORATORY TESTS

Laboratory tests were carried out by way of reasonable technical trials, by personnel of the applicant's wholly owned subsidiary namely Sappi Timber Industries (Proprietary) Limited on wood particles and chips as used for manufacturing chipboard in the factories of the aforementioned company.

Using the aforementioned raw materials, binder mixtures of urea-formaldehyde resin as typically used in the aforementioned company's production facilities were applied to the aforementioned particle chips,

and compared with urea-formaldehyd mixtur s including MDI, and further compared with mixtures of urea-formaldehyde with MDI and various catalysts as set out above.

The resulting mixtures of particles/chips and binder mixtures were pressed in a laboratory scale press to simulate plant production conditions, and curing times were measured. In the binding mixtures that did not include a catalyst, longer curing times were observed.

Details of the mixtures used and the corresponding results are set out in Table 1 hereafter:

TABLE 1

MIXTURE ADDED TO UF RESIN	INCREASE IN PRODUCTION SPEED (%)
MDI + RELEASE AGENT 1.4 % (on BDW) of MDI + 0.5 % (on UF solids) Internal Release and Wetting Agent	34.6
MODIFIED MDI	
(a) 1.4% (on BDW) MDI modified with PPG diol MDI pre-polymer	44.3
(b) 1.4% (on BDW) MDI modified with PPG Triol MDI pre-polymer	44.3
(c) 1.4% (on BDW) MDI modified with TDI	44.3
(d) 1.4% (on BDW) MDI modified with PPG Triol TDI pre-polymer	42.4

Table 1 (Contd)

CATALYSTS	
(a) 1.4% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% DABCO TMR 2 catalyst	45.8
(b) 1.4% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% (on UF mass) DABCO K 15 catalyst	44.3
(c) 1.4% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% (on UFmass) DABCO DC 2 catalyst	44.3
(d) 1.2% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% (on UFmass) DMCHA catalyst	42.3
(e) (1.2% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% (on UF mass) DABCO R8020 catalyst	42.3
(f) 1.2% (on BDW) MDI modified with PPG Triol MDI pre-polymer + 0.1% (on UF mass) Thorcat catalyst	40.0
(g) 1.4% (on BDW) MDI modified with Polyethylene glycol MDI pre-polymer + 0.1% (on UF mass) DABCO DC 2 catalyst	42.8
(h) 0.5% (on BDW) MDI + 1.1% (on UF mass) DMEA catalyst	33.3
(i) 0.5% (on BDW) water emulsified MDI + 1.1% (on UF mass) DMEA catalyst	33.3

In th aforementioned table, the brand name Daltolac R130 is a brand name for polyether polyol, which is sold by ICI (Imperial Chemical Industries). Similarly PPG diol MDI Pre-Polymer is the brand name for polypropylene glycol diol MDI pre-polymer and PPG triol TDI Pre-Polymer is the brand name for polypropylene glycol triol TDI pre-polymer.

The curing times for mixtures where typically 0.1% to 1.9% MDI and one or more of the abovementioned catalysts were added (on BDW), were the shortest.

The results of the above tests indicated that in all cases the binding mixtures with MDI and one or more catalysts resulted in a shorter curing period with the same or an increased binding strength.

It was also found that the use of amines as catalysts alone resulted in the least costly mixture and hence the most cost-effective process(es).

2. PRODUCTION-PLANT TRIALS

The aforementioned tests were repeated by way of reasonable technical trials, on two different production lines namely one using a single daylight press and the other using a continuous press. Details of the

mixtures used and the c rresponding results are set out in Tabl 2 hereunder:

TABLE 2

MIXTURE ADDED TO UF RESIN	INCREASE IN PRODUCTION SPEED (%)
CONTINUOUS PRESS WHITE RIVER FACTORY 0.5% (on BDW) waster emulsifiable MDI + 1.1% (on UF mass) + DMEA catalyst	14.3

The abovementioned production-line tests confirmed the aforementioned laboratory results, with improvements in or increased curing times of up to approximately 14 to 24%. The applicant believes that it may be possible to achieve greater improvements than the aforementioned.

It will therefore be seen from the aforementioned that a considerable improvement in curing times and hence in productivity may be possible by using the aforementioned invention. Such improvement also appears to be cost-effective relative to increased productivity and production on an industrial scale.

Although certain embodiments only of the inventi n have been described herein, it will be apparent to any person skilled in the art that other variations and/or modifications of the invention are possible. Such variations and/or modifications are therefore to be considered as falling within the spirit and scope of the invention as claimed hereinafter.

CLAIMS

1. A binding mixture for use in manufacturing chipboard, the mixture including an effective amount of methyl di-isocyanate ("MDI") and one or more polyurethane catalyst(s) being selected from the following:

   (a) one or more amine compound(s) including aliphatic and aromatic tertiary amine derivatives of phenols, esters, ethers, alkenes and/or alcohols; or

   (b) one or more organometallic compounds of tin, bismuth, zinc, iron, and/or alkali metal salt(s); or

   (c) suitable mixtures of (a) and (b) above.

2. A binding mixture as claimed in claim 1, wherein the MDI is water-emulsifiable.

3. A binding mixture as claimed in either claim 1 or claim 2, wherein the or each polyurethane catalyst(s) is/are (a) delayed-action catalyst(s).

4. A binding mixture as claimed in any one of the preceding claims, wherein an effective amount of toluene di-isocyanate ("TDI") is added to the MDI.

5. A binding mixture as claimed in any one of the preceding claims, wherein one or more internal wetting and release agents is/are added to the mixture.

6. A binding mixture as claimed in any one of the preceding claims, wherein a suitable amount of urea-formaldehyde resin is added.

7. A binding mixture as claimed in claim 6, wherein a suitable quantity of or more one polyol(s) is/are added.

8. A binding mixture as claimed in either claim 6 or claim 7, wherein the amount of formaldehyde in the urea-formaldehyde resin may be approximately 50% (in moles).

9. A binding mixture as claimed in any one of the preceding claims, wherein the or each suitable amine(s) or amine compound(s) are selected from the following:

2-dimethyl ethanolamine ("DMEA");

di-amino bicyclo-octane ("DABCO"); and

N,N-dimethyl cyclohexylamine ("DMCHA").

10. A binding mixture as claimed in any one of th pr ceding claims, wherein th or each suitable organometallic tin-based compound(s) is/are selected from the following:

Stannous octoate, dibutyl tin dilaurate, dibutyl tin mercaptide, dibutyl tin thiocarboxylate, and dioctyl tin thiocarboxylate.

11. A binding mixture as claimed in any one of the preceding claims, wherein the suitable organometallic compounds include ferric acetylacetonate.

12. A binding mixture as claimed in any one of the preceding claims, wherein the suitable alkali metal salts are selected from the following:

calcium carbonate, salts of carbonic acid, and salts of acetic acid.

13. A binding mixture as claimed in any one of the preceding claims, wherein the amount of MDI required to effect a suitable hastening of the curing process is in the range of from about 0.1% to 1.9% of bone dry wood ("BDW").

14. A binding mixture substantially as herein described and/or exemplified.

15. An additive for a binding mixture for us in manufacturing chipb ard, th additive including an effective amount of MDI and a catalyst, each catalyst being as claimed in any one of the preceding claims.

16. An additive for a binding mixture for use in making chipboard, substantially as herein described and/or exemplified.

17. A process for manufacturing chipboard, the process including the steps of adding to or using in a binding mixture an effective amount of MDI and a catalyst, each catalyst being as claimed in any one of claims 1 to 14, and suitably mixing the binding mixture with wood particles and/or chips.

18. A process for manufacturing chipboard, the process including the steps of adding to or using in a binding mixture an effective amount of an additive as claimed in either claim 15 or claim 16, and suitably mixing the binding mixture with wood particles and/or chips.

19. A process for manufacturing chipboard, substantially as herein described and/or exemplified.

INTERNATIONAL SEARCH REPORT

Int...ational Application No
PCT/ZA 00/00019

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C08L97/02 C08G18/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C08L C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 09645 A (WEYERHAUSER) 11 June 1992 (1992-06-11) page 4, line 30 -page 5, line 19; claims 1-4,8-11; examples 5-7	1,3,9,10
X	EP 0 039 137 A (IMPERIAL CHEMICAL INDUSTRIES) 4 November 1981 (1981-11-04) page 3, line 12 -page 4, line 30	1-3
X	EP 0 346 059 A (NATIONAL RESEARCH DEVELOPMENT) 13 December 1989 (1989-12-13) page 3, line 18 - line 22; claim 1; example 9	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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16 May 2000	24/05/2000

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